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N. Mozga / F. Sudnieks / I.Grinevichs

Quality assurance of performance of automatic assembly operations on rotors

QUALITY MEASUREMENT AND INDUSTRIAL IMAGE PROCESSING

Abstract. In given article it is shown, that from standard parameters of a roughness only two influence on accuracy of performance of assembly process, namely: arithmetical mean deviation of the profile (Ra) and mean spacing of the profile irregularities (Sm).

1. Automatic connection of details. During optimization of technological process of assembly on rotary automatic devices, except for other problems, it is necessary to solve the problem of quality assurance (specifically the metrology assurance). It is known, that the decision of these questions gives the greatest technical and economic effect and demands thus the least expenses only when is carried out at the initial stages of creation of new kinds of production, development and mastering of technological processes, and also at the organization of manufacture.

At automatic connection of details on rotary automatic devices application of working power heads almost always is required as it is not necessary to count that assembled details to join with each other only owing to gravity. Necessity of compulsory connection of details is caused by impossibility absolutely precisely to orientate details rather each other; requirement to increase of productivity of the automatic assembly equipment; and also presence of roughness on interfaced and directing surfaces and front-end facets (edges).

2. Roughness in interfaced surfaces. From above told follows, that the roughness of interfaced surfaces, among other major factors, influences on the value of assembly afford.

Let’s consider process of connection of details after they have contacted with each

other (Figure 1). Contact interaction of details in units of friction is concerned with geometrical and physicomechanical parameters of quality of interfaced surfaces. Roughness (microroughnesses), a direction of roughnesses, accuracy of the form of details are concerned with the first group of parameters – with geometrical parameters; among physicomechanical parameters (that is the second group of parameters) are microhardness of a surface, degree and the depth of cold-hardening, etc.[1, 2].

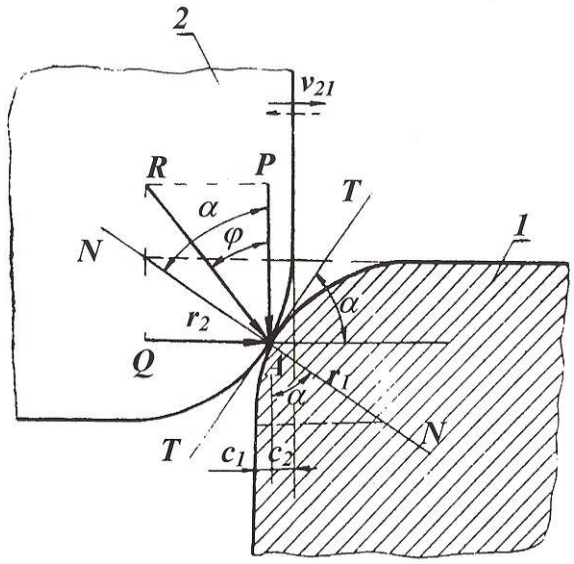


Figure 1: Scheme of contact of two details

In the general case of contact the microroughness undergo both elastic, and plastic deformations. In an initial stage the micropeakes are deformed elastically, bet in the process of achievement of some critical size (critical rapprochement) the plastic current of a peak is begin. The kind of contact depends on elastic properties of a material and microhardness of a superficial layer.

In assembly process change of a microrelief is not supposed at contact of details and besides the forces of friction, arising between contacted surfaces, should be minimal – hence at interaction of roughnesses of one surface with another their elastic deformation should be provided.

Let's define what microgeometrical parameters and physicomechanical characteristics it is necessary to consider at a choice of a material and a kind of processing of collected details.

3. Elastic deformation of micropeaks. Let's consider an elastic kind of contact for the case most widespread in practice when one detail is much more smoothes than another one and its roughness can be neglected. Then dependences for definition of the relative area of contact η_{el} and specific pressure q_{el} can be presented in a following kind [3]:

$$\eta_{el} = k_{\eta} \left[1 - \Phi \left(y \right) \right] ; \quad (1)$$

$$q_{el} = k_q^{el} \frac{Ra}{\Theta \cdot Sm_1} \cdot F_1(y) , \quad (2)$$

where k_{η} and k_q^{el} – the factors depending on anisotrophy of roughness C;

$\Phi(\gamma)$ – Laplace function in the form of $\Phi \left(\gamma \right) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\gamma} e^{-t^2/2} \, dt$

$F_1(\gamma)$ – the function depending on a level of deformation γ ;

γ – level of deformation, which is normalize on size σ;

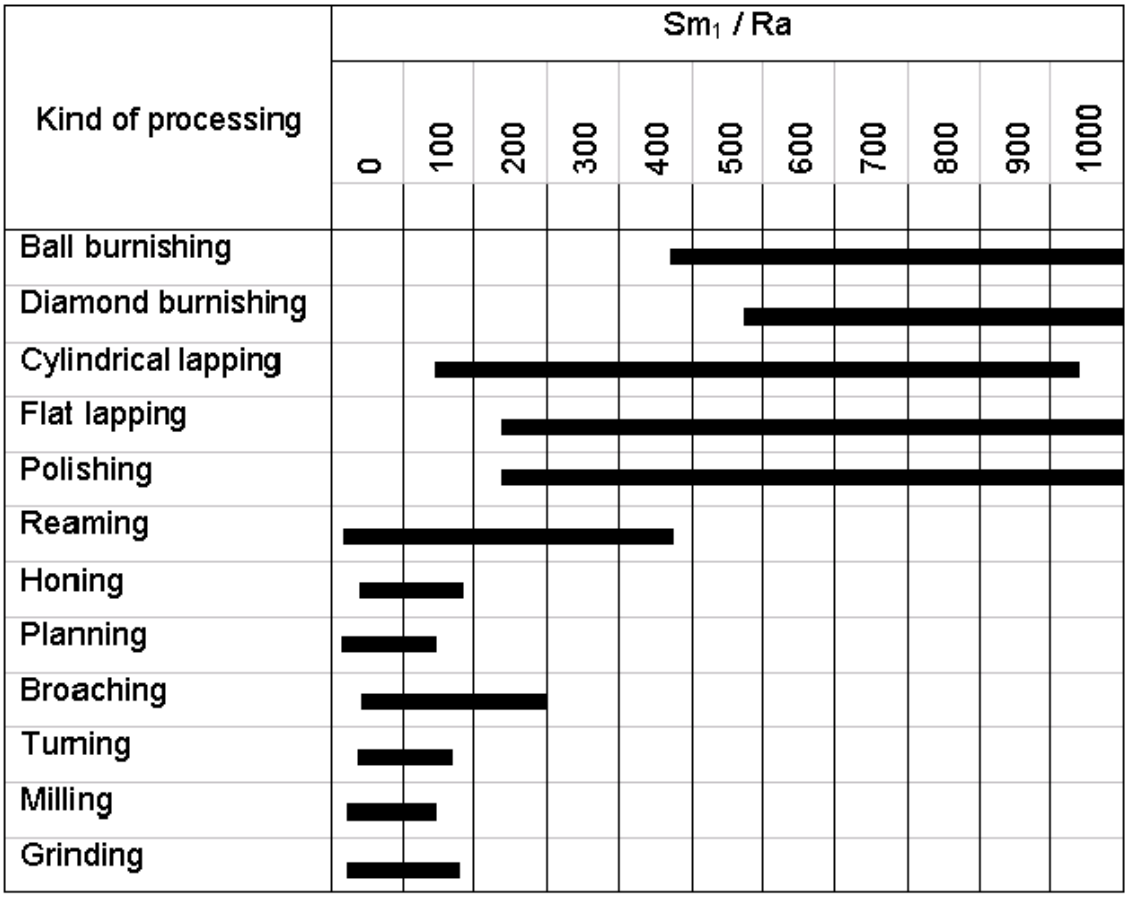
$\Theta = \frac{1 - \mu^2}{\pi E}$ – elastic constant of a material (μ - Poisson's ratio, E - coefficient of elasticity);

Ra – arithmetical mean deviation of the profile

Sm_1 – mean spacing of the profile irregularities.

Studying the influence of the initial sizes entering into the formulas (1) and (2), it is possible to note, that its contain attitude of Sm_1 / Ra. It means, that at contacting of details heights and steps of roughnesses don't play the important role, and their attitude does it. Dependences of the attitude of parameters Sm1 / Ra from a kind of processing are tabulated (Table 1).

Table 1: Dependences of the attitude of parameters Sm1 / Ra from a kind of processing



Besides at calculation it is necessary to consider anisotropism of a roughness C and elastic constants of a material - E and μ. These parameters are easy for operating during manufacturing details.

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Authors:
Dr.sc.ing. Natalija Mozga
As.Prof. Dr.sc.ing. Francis Sudnieks
M.sc.ing. Ivan Grinevichs
Riga Technical University, Mechanical Engineering Institute, Ezermalas Str. 6
LV-1006, Riga, Latvia
Phone: +371 7089701
Fax: +371 7089739
E-mail: natalija.mozga@inbox.lv